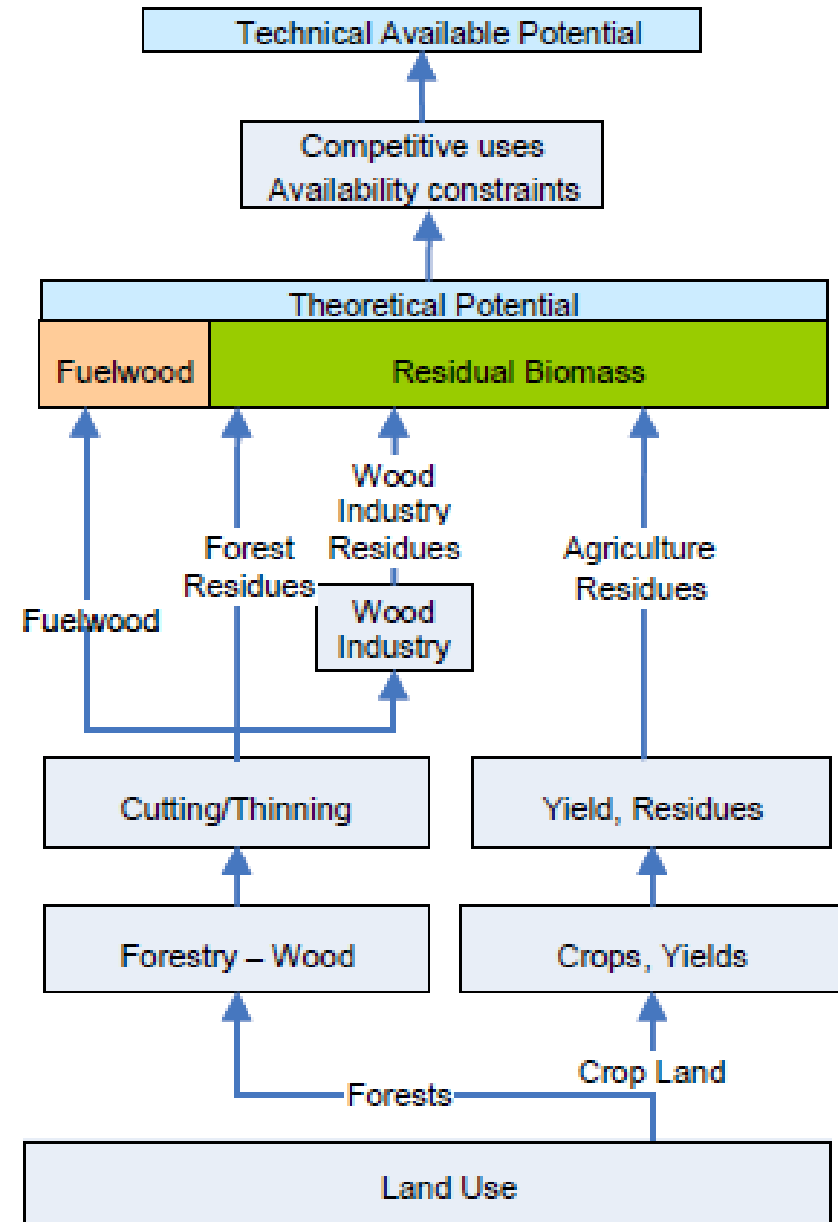


Biomass potential in FBiH

(for purpose of use biomass for
cofiring in Thermal power plants)

Anes Kazagic,
JP Elektroprivreda BiH d.d. Sarajevo

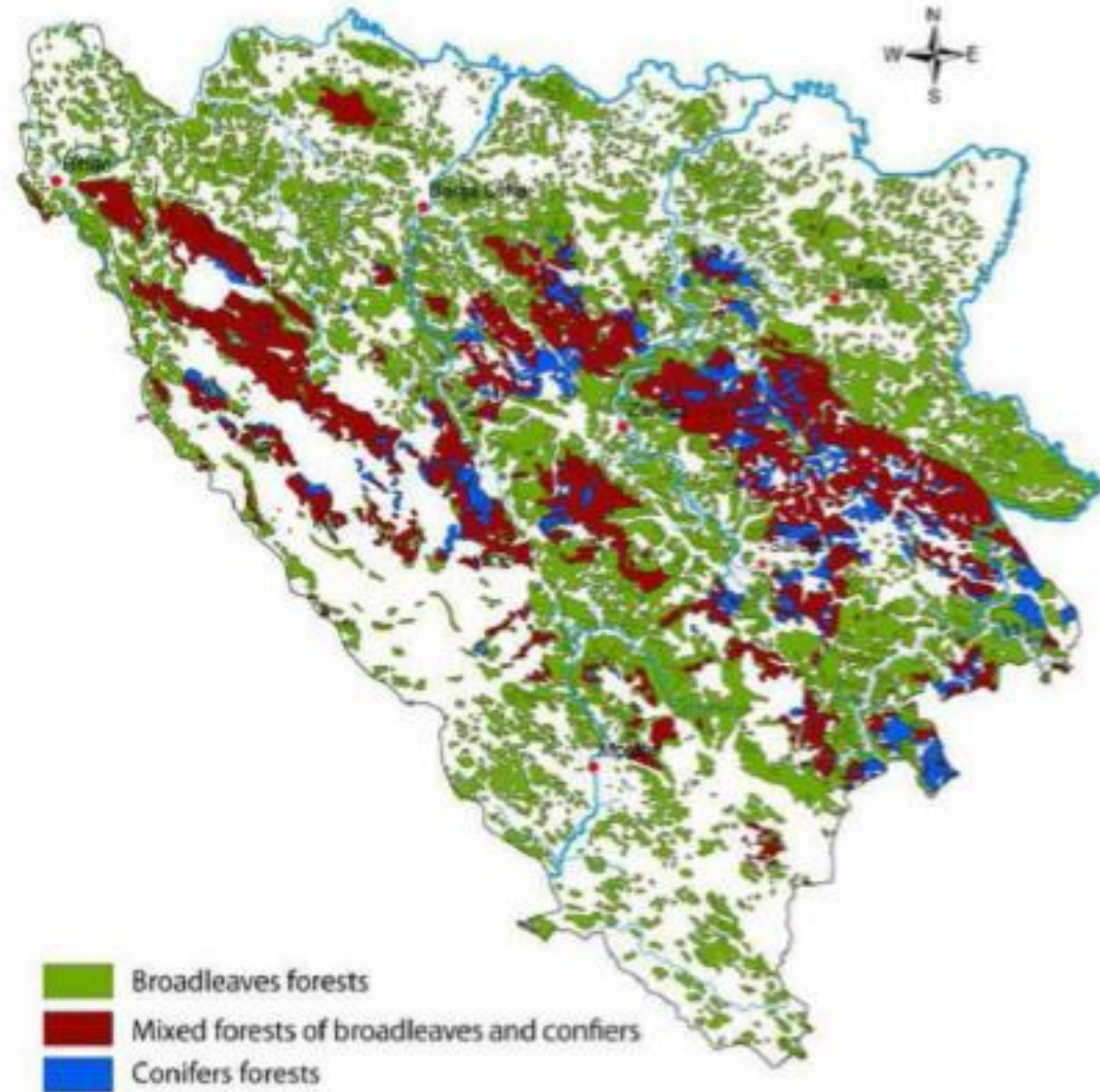
Bottom up approach to estimate biomass potential_Perakis at al



Forest Sector

Diversification of forest species in BiH_

Stefanović and Beus



Production of forest sortiments in Bosnia and Herzegovina_Agency for Statistics of Bosnia and Herzez.

year	000 m ³							
	2006	2007	2008	2009	2010	2011	2012	2013
Total	4 104	3 753	4 011	3 429.	3 615	3 500	3 786	4 024
Coniferous	1 749	1 592	1 722	1 396	1 578	1 580	1 754	1 944
Logs, coniferous	1 349	1 196	1 308	1 029	1 060	1 048	1 177	1 256
Mining wood, coniferous	113	103	109	84	102	119	113	136
Other long wood, coniferous	129	114	116	77	83	93	75	14
Cordwood, coniferous	145	169	182	204	330	319	388	536
Fuelwood, coniferous	13	11	8	2	2	2	2	1
Bread leaf	2 355	2 161	2 289	2 033	2 037	1 920	2 033	2 080
Logs, broadleaf	800	728	733	568	598	568	613	643
Mining wood, broadleaf	8	9	6	7	7	6	5	4
Other long wood, broadleaf	12	15	13	13	16	14	17	16
Cordwood, broadleaf	88	81	103	118	158	127	131	82
Fuelwood, broadleaf	1 446	1 328	1 432	1 327	1 258	1 205	1 266	1 334
Other wood, roughly worked	0,6	0,3	0,3	0,6	0,7	0,7	0,05	0,4

Available quantities of wood biomass for energy production_UNDP

Sources	Conifers (m ³)	Deciduous trees (m ³)	Total (m ³)
Cordwood for energy	1.711	1.228.441	1.230.152
Residues after cutting and production of wood products	342.181	261.154	603.335
Small branches	314.181	401.432	715.613
Residues and waste after production of sawn timber, veneer and furniture	354.857	200.843	555.700
Stumps	314.848	334.527	649.375
Total (m ³ /year)	1.327.778	2.426.397	3.754.175
Total [t/year]:	557 947	1 747 005	2 304 952
Total [toe]	209 223	588 343	797 567

Quantities, types, structure and energy-related potential of wood residue in Bosnia and Herzegovina_UNDP

			Quantities	Quantities	Minimum inferior calorific value	Energy potential
Unit			m ³ /a	t/a	GJ/t	TJ/a
Wood residues from forestry		broadleaf	295.529	212.781	10.28	2187
		conifers	202.866	91.290	10.28	938
Sawmill wood residues	Sawdust	broadleaf	283.300	203.976	10.29	2097
		conifers	145.227	65.352	10.28	672
	Wood chips	broadleaf	212.475	152.962	10.28	1573
		conifers	145.227	65.352	10.28	672
Total			1.284.624	791.713		8139

Forest areas per forestry centrals in Bosnia and Herzegovina, ADEG Project

Number of region	Name of region	Forest area (ha)
1*	Unsko–sanski kanton	170 892
2*	Posavski kanton	268 392
3*	Tuzlanski kanton	33 828
4*	Zeničko-dobojski kanton	134 230
5*	Bosansko-podrinjski kanton	64 663
6*	Srednjo-bosanski kanton	21 958
7*	Hercegovačko-neretvanski kanton	75 682
8*	Zapadno-hercegovački kanton	172 297
9*	Kanton Sarajevo	175 939
10*	Kanton br. 10	1 820
11**	Banja Luka region	244 576
12**	Bijeljina region	61 514
13**	Doboj region	73 100
14**	Trebinje region	115 212
15**	Sarajevo region	147 341
16*	Brčko District B&H	2 080
Total***		2 373 172

Annual production of wood assortment in m³ (logs, fuelwood, wood residues) per regions of Bosnia and Herzegovina_GEF UNDP and ADEG

Forestry central	Logs	Fuelwood	Wood residues	Total
Unsko-Sanski kanton (FBiH)	377 407	153 532	78 768	609 707
Posavski kanton (FBiH)	7 299	3 791	1 548	12 638
Tuzlanski kanton (FBiH)	224 970	101 407	47 293	373 670
Zeničko-Dobojski kanton (FBiH)	654 350	210 397	134 653	999 400
Bosansko-Podrinjski kanton (FBiH)	40 362	25 588	8 738	74 688
Srednjobosanski kanton (FBiH)	570 226	193 338	117 685	881 249
Hercegovačko-Neretvanski kanton (FBiH)	130 658	66 331	27 721	224 710
Zapadnohercegovački kanton (FBiH)	28 207	17 060	6 079	51 346
Kanton Sarajevo (FBiH)	198 267	66 341	40 888	305 496
Kanton br. 10 (FBiH)	563 481	109 937	113 514	786 932
Banja Luka region (RS)	834 278	289 442	127 634	1 251 354
Bijeljina region (RS)	154 889	69 983	26 982	251 854
Doboj region (RS)	123 078	71 104	23 300	217 482
Trebinje region (RS)	177 373	27 441	24 575	229 389
I. Sarajevo region (RS)	509 366	59 004	69 128	637 498
Brčko District B&H	3 420	2 267	683	6 370
Total	4 597 627	1 466 973	849 181	6 913 783

*Categories of wood products_RS Institute of Statistics,
2013; FBiH Ministry of Economy, Water Management
and Forestry, 2013*

	FBiH	RS	BiH
Logs	905.830	862.997	1.768.827
Other round wood	53.952	84.811	138.763
Pulpwood	248.017	340.073	588.090
Firewood	669.375	560.777	1.230.152
Net mass of large wood	1.877.174	1.848.658	3.725.932
Residue after cutting and production of forest wood products	306.569	296.765	603.334
Gross mass of large wood	2.183.743	2.145.423	4.329.166

Total biomass technical potential in Bosnia and Herzegovina_ADEG

The origin of biomass	Available biomass	Energy potential of biomass (PJ)
Wood residues from industry, m ³	1 142 698	7.533
Fuelwood, m ³	1 466 973	13.201
Wood residues from forestry, m ³	599 728	2.623
Total technical potential		23.357

Annual cutting of forests by municipalities in the two cantons (K4 and K6) in FBiH_SIDA

Municipality	K4 (Zeničko-Dobojski kanton)		Municipality	K6 (Srednjobosanski nanton)	
	Conifers	Broadleaves		Conifers	Broadleaves
Olovo	102.600	51.007	Travnik	99.521	41.658
Zavidovići	74.146	127.411	Fojnica	22.164	97.464
Kakanj	25.879	43.077	Bugojno. Donji Vakuf, Gornji Vakuf	62.411	36.102
Vareš	164.457	37.381	Busovača	23.025	34.303
Visoko	122	17.514	Novi Travnik	29.434	30.639
Teslić	5.897	8.284	Vitez	23.948	8.303
Tešanj	139	2.855	Jajce	45.726	20.887
Žepče	1.498	10.838	Kreševo	9.327	36.022
Total	335.039	294.739	Kiseljak	2	7.529
			Total	315.556	312.905

The available wood residues from forestry and industry in cantons K4 and K6, SIDA

Region	Wood residues from forestry (m ³)	Wood residues from industry (m ³)	Total (m ³)
K4 + K6	176.262	153.944	330.236

The assumption of the amount and way of use of the biomass in cantons K4 and K6

Region	The ways of current use of biomass			Total used biomass (m ³)	Total available biomass (m ³)	Non-used (m ³)
	Firing (m ³)	Sales (m ³)	Briquette and pellet production (m ³)			
K4 + K6	46.168	23.084	7.100	76.352	330.209	253.857

Chemical analysis of wood residues from wood industries originated of beech (50% water) and spruce (10% water)_Faculty of Mechanical Engineering Sarajevo

Type of analysis	Unit	Wood residues of beech (as received)	Wood residues of spruce (as received)
Humidity (total)	% m/m	43,00	11,02
Ash	% m/m	0,33	0,26
Volatility		49,62	75,48
Combustable	% m/m	56,67	88,54
Coke	% m/m	7,38	13,32
C (fix)	% m/m	7,05	13,06
C (total)	% m/m	13,23	38,91
H	% m/m	8,36	7,36
N	% m/m	0,05	0,33
O	% m/m	34,84	41,61
HCV	kJ/kg	10.741	17.386
LCV	kJ/kg	8.030	15.612
S (total)	% m/m	0,19	0,33

Agricultural Sector

Total energy biomass technical potential from agriculture in Bosnia and Herzegovina_ADEG, ECS

Biomass origin	Available biomass	Energy potential (PJ)
Biogas from livestock manure, m ³	20 100 000	0.508
Arboricultural residues, t	211 257	0.739
Straw (field crop residues), t	634 000	8.876
Leguminosae and oil crops residues, t	3 857.6	0.038
Total	-	10.161

Energy crops

Crop	End use	Energy potential (PJ)	
		Scenario A	Scenario B
Oilcrops	1st gen. Biodiesel	2,12	3,26
Wheat	1st gen. Bioethanol	2,13	3,26
Maize	1sr gen. Bioethanol	2,88	4,42
Perennial grasses	2nd gen. Bioethanol	7,76	11,82
	Heat & electricity	15,33	23,54
SRC (Short rotation Coppice)	2nd gen. Bioethanol	6,21	9,53
	Heat & electricity	12,26	18,83

*Proximate analysis of oven dried samples of
Miscanthus Giganteus (samples from three trial
locations: Tuzla, Butmir, Rogatica)*

Trial locations	Volatiles (%)	Ash (%)	Fixed carbon (%)	Gross calorific value (GJ/t)
Miscanthus Giganteus (Tuzla)	85,99	5,50	8,51	18,6
Miscanthus Giganteus (Butmir)	87,03	2,58	10,39	18,9
Miscanthus Giganteus (Rogatica)	83,09	7,88	9,04	17,6
Average values (Miscanthus Giganteus BiH)	85,37	5,32	9,31	18,4

Potential biomass yield in tons of dry matter (10 – 12) of *Miscanthus x giganteus* grass by counties of Bosnia and Herzegovina on poor quality soils (fallow land and unfarmed land)

County	5% used area	10% used area	15% used area
FBiH			
Republika Srpska			
Zeničko-Dobojski Kanton			
Srednjobosanski Kanton			
Kanton Sarajevo			
Tuzlanski Kanton			
Brčko Distrikt BiH			
BiH (total)	273.000 – 327.600	546.000 – 655.200	819.000 – 982.800

Biomass that can be used now

Biomass from forest

- Taking into account the mentioned data of annual felling, production of wood assortments, and results of the survey that we have recently done, the amount of wood residues is assumed to the following figures: 500.000 – 650.000 m³ of wood residues in the forestry (1/2 is available for use), that's ca. 300.000 m³ in BiH). It is possible to find that the most of wood residues from forestry are almost not used, even 50 % of them could be used. When we talk about the TPPs of JP Elektroprivreda BiH regarding the available biomass from forestry we can conclude as following:
- The interesting areas with the biomass potential that could be used for cofiring in TPPs are: Cantons K4 – Zeničko-Dobojski Kanton, K6 – Srednjobosanski Kanton and K9- Sarajevski Kanton for TPP Kakanj (distance from 10 – 100 km), and Canton K2 – Tuzlanski Kanton and a north and northeastern part of RS (Bijeljina and Dobojski region) for TPP Tuzla (distance from 10 – 100).
- Taking into account the percentage of annual felling and production of wood assortments in the mentioned regions (ca. 10-15 % around the TPP Tuzla, and 30-35 % around the TPP Kakanj), the available potential of biomass from forestry is ca. 30.000 - 45.000 m³/a for TPP Tuzla, and 90.000 – 105.000 m³/a for TPP Kakanj). The supplier of the biomass from forestry for TPP Tuzla would be 2 forest management companies (one from FBiH – Forest Management Company from Tuzlanski Kanton and one from RS – Šume Republike Srpske), but supplier of the biomass from the forestry for TPP Kakanj would be 3 (cantonal) forest management companies from FBiH (Srednjobosanski Kanton, Zeničko-Dobojski Kanton i Sarajevski Kanton).

Biomass from wood process industry

- Taking into account that only 10 % of biomass is currently available for use, and disposition of wood processing industry companies, we could say that available biomass from wood processing industry (not incl. biomass for pellets, accounting app 200.000 t/a) for cofiring in the TPPs of JP Elektroprivreda BiH are as following:
 - 10.000 – 15.000 m³/a for TPP Tuzla, and
 - 30.000 – 35.000 m³/a for TPP Kakanj

Biomass from agriculture

Taking into account the place of TPPs and market of biomass residues from agriculture, it could be said that available biomass from agriculture for TPP Tuzla (distance from TPP up to 80 km) could be up to 100.000 t/a (K2 - Posavski Kanton i K3 -Tuzlanski Kanton from FBiH and Bijeljina region from RS), and up to 25.000 t for TPP Kakanj (K4 - Zeničko-Dobojski Kanton, K6 - Srednjobosanski Kanton and K9 - Sarajevski Kanton)

Conclusions

1. Significant potential: forests, wood industry, agriculture, energy crops.
2. Potential is not used.
3. Poor biomass collecting infrastructure is the largest obstacle.
4. Pellet export is to be redirected to domestic consumers, due to CO2 certificates.
5. Support mechanism is to be developed (e.g. Feed-in for biomass and cogeneration increased...)

Thank you for your attention

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